

Island, as it is termed in the Voyage of the 'Rattlesnake,' agrees precisely with Reeve's types, excepting that the aperture is not quite so reddish within.

16. *Melania Petiti*, Philippi.

Hab. Rossel Island (*Thomson*).

Dr. Brot has kindly identified this species. All the specimens are small and have only the last and penultimate whorls remaining, producing a remarkably truncated appearance.

EXPLANATION OF PLATE XIII.

- Figs. 1, 2. Pupinella Macgregori.*
Figs. 3, 4. Pupinella louisianensis.
Figs. 5, 6, 6 a. Pupinella rosseliana.
Figs. 7, 8. Pupinella minor.
Figs. 9-11. Trochomorpha nigrans.
Figs. 12, 13. Helix (Geotrochus) Thomsoni.
Fig. 14. Helix (Chloritis) subcorpulentus.
Fig. 15. Nanina rosseliana.
Fig. 16. Nanina inclinata.
Fig. 17. Helicina congener.

XXIII.—On the Habits of certain Bornean Butterflies.
By SYDNEY B. J. SKERTCHLY, F.G.S., M.A.I.*

I. *Introduction.*

The following notes on the habits of butterflies are chiefly from observations made in British North Borneo. They were mostly written in the jungle, and every observation was recorded at the time. I was often for days amid such a wealth of gorgeous *Ornithopteras* and *Papilios*, &c., that any little point suggested while writing could be observed and any ambiguity be corrected without leaving the open-sided hut. This, however, is unhappily a rare chance, and seldom lasts long at a time.

II. *The Hours of Appearance and General Habits.*

As a rule our butterflies do not come out until about seven o'clock—that is, an hour after sunrise. By this time the

* [Since I communicated Mr. Skertchly's interesting notes "On Butterflies' Enemies," which appeared in the 'Annals,' ser. 6, vol. iii. p. 477, I have received some further observations of great interest to lepidopterists, which I now forward for publication.—W. L. DISTANT.]

heavy night dews have evaporated and the jungle is as dry as it ever gets in this hot-house climate. They increase in numbers, until about ten or eleven o'clock a maximum is reached, and a lull sets in for a couple of hours, though there are still many about. From one till two o'clock they swarm again, and then gradually decrease in numbers, until soon after four most of them have gone, and the crepuscular forms like *Melanitis* and *Amathusia* appear soon after. A passing cloud or shower causes a sudden disappearance of nearly all the species, though a few brave the gloom and rain.

The most persistent species I know is *Ornithoptera flavicollis*, which is up earliest, retires latest, scorns the clouds, and may be seen, dripping wet, lazily flapping along in a smart shower. The *Hestias* emulate it with considerable success, and some of the *Dunais* genus are very early risers, but pitch during cloud and rain, though often on exposed shrubs, where, with folded wings, they patiently get wet. The bright brown *Pandita senora* is another early riser, flies low, and delights to bask in the early morning sun, and in the afternoon mounts high like the *Euplœas* and *Ideopsis*.

North Borneo, especially in its eastern part, where my observations were chiefly made, is practically one unbroken virgin forest, intersected by innumerable creeks and small streams and some fine rivers, such as the Labuk, Kinabatangan, and Segama. The average height of the forest is between 150 and 200 feet, and, save where a tree has fallen, the sun's rays never penetrate, and all is shade, warm, moist, and equable. On the banks of the rivers and their larger tributaries sunshine is abundant, while over the smaller creeks the meeting branches form a canopy almost as dense as in the forest itself. Save along the larger rivers and on the coast there are no inhabitants, and even there the native clearings are very small. Even around the capital, Sandakan, virgin forest begins within a mile, and in the forest there are no clearings whatever, and nature, untouched by man, can be contemplated in its purity.

But in the forest depths butterflies are rare, and the following genera alone supply true forest species, that never seek the sunny river-banks or bright glades and clearings:—

NYPHALIDÆ.

Ragadia.	Thaumantis.
Neorina.	Clerome.
Amathusia.	Xanthotœnia.

ERYCINIDÆ.

Abisara.

LYCÆNIDÆ.

Nacaduba.
Lampides.Biduanda.
Narathura.

PAPILIONIDÆ.

None.

HESPERIIDÆ.

None.

All the other genera and many species of those enumerated delight either in the sunshine or the shady forest edges, forest paths, or clearings, where the light is stronger than in the forest depths and where sunshine is close at hand. Occasionally *Ornithoptera* and *Hestia* make excursions into the jungle; but their haunts are the forest by the river-sides. *Euthalia* and *Tanœcia* are still more frequent explorers of the forest depths, but they chiefly affect the more open places. Other genera are not unfrequently observed, but they are stragglers.

The most plentiful butterflies in the forest are the blues and purples, which frequent the higher undergrowth and have a strong tendency to settle in the middle of leaves which turn their upper surface horizontally. The purples perhaps, such as *Narathura*, are more arboreal than the blues and fly higher, even up to 60 feet; but as a rule the forest butterflies keep pretty low down.

It has been suggested that the rarity of butterflies in the deep forest shade is more apparent than real and that the mass of the individuals are high overhead on the tree-tops. This is certainly not the case in North Borneo, for I have had ample and unusual opportunities of seeing over the forest. Some of the mountains, about 3000 feet high, run up in long ridges and terminate in a pinnacle, and on several occasions their summits were chosen as stations for getting bearings during jungle surveys. The trees on the summit were felled and a station rigged up, upon which the observer more than once sat from dawn to dusk for days together. The tree-tops were all around and insects as easily seen as when down below. In every case butterflies were rarer than on the river-banks below. The only species at all common were small blues, and only now and then did others come sailing by. Nowhere, even where trees were in flower, were butterflies seen playing about in numbers, though swarms of bees, all flying up the wind, were common, and wasps, flies, and beetles were far from rare.

The conclusion I have come to is that the great bulk of the butterflies are confined to the river-valleys, that they only take occasional journeys into or over the forest, and that clearings, by opening up the forest, give rise to an actual increase in the number of butterflies which prefer sunshine and partial shade.

The majority of butterflies still fly near the ground, possibly all did originally, and certainly in this tropical primeval forest very few, if any, habitually frequent tree-tops. This is instructive, as our forest is very peculiar in one feature—it is never swept by storms. The north-east coast of Borneo enjoys perpetual calm weather, nothing approaching a gale is known, a stiff breeze is a rarity and seldom endures for an hour. Butterflies therefore are not debarred from the forest-top by heavy weather; they voluntarily avoid it.

We have many flowering creepers which ascend the tree-trunks, and most of our orchids live high up on the trees; yet as a rule they do not attract butterflies, though bees swarm over them. This seems to point, as many other facts do, to butterflies being still as much terrestrial as aerial creatures.

III. *Habits of particular Species.*

There is an infinite variety in the general habits of butterflies; but as a special paper is in preparation on their flight, I will here only give a few particulars on other points.

Most butterflies in settling do so more or less deliberately; they fly direct to the object, slow down their speed, pitch quietly, and adjust their wings slowly. But the leaf-mimickers, like *Amathusia*, *Thaumantis*, *Discophora*, *Precis*, and *Kallima*, behave quite differently; they fly rapidly along, as if late for an appointment, suddenly pitch, close their wings, and become leaves. It is generally done so rapidly that the insect seems to vanish. *Amathusia phidippus*, a crepuscular species, has been frequently observed on a forest-path over which depend many creepers. It hurries along, suddenly pitches, always head downwards, and is a dead leaf. Many leaf-butterflies have escaped our nets because, though we have carefully marked them down, we have hesitated too long as to which leaf to catch.

It may here be remarked that the degree of verisimilitude as observed in the cabinet has no relation to the real powers of concealment. *Kallimas* are the most perfect leaf-butterflies; but they are not really more difficult to detect than the apparently much less leaf-like *Zeuxidias* or *Amathusias*. So

innumerable are the shapes, markings, and fractures of dead leaves that but a very sketchy likeness to a good, well-preserved, dead leaf is sure to appear perfectly natural in the jungle.

Our Borneo butterflies are proof against the seductions of sugar, even when flavoured with square-faced gin. We often tried to tempt them, but they took no notice, and we never had any chewed sugar-cane, which Mr. Pryer says they like. Even the bees generally despised our sugar, though they would come in swarms to our dried salt fish and even to plain salt. This love of salt was shared in a modified degree by butterflies of the genera *Papilio*, *Catopsilia*, *Charaxes*, and others, chiefly whites. The *Papilios* of the *sarpedon* types, and I never saw the dark *memnon* types touch it. When camped on a stream our dyaks always took their fish to soak and wash in the running water before cooking it; and the spots where the fish were laid on the sand were often perfectly smothered with butterflies. They showed no fear and would come while the dyaks were at work. *Curetis* will often settle on the salt fish when it is drying, and be so intent on feeding that it can be picked up. Generally these salt-resorts were smothered with the following species:—

- Papilio sarpedon*. Most common.
- *agamemnon*. Common.
- *evemon*. Less common.
- *mecisteus*. Fairly common.
- *telephus*. Fairly common.
- *bathycles*. Fairly common.
- *arcyles*. Less common.
- Hebomoia* —? Rare.
- Catopsilia crocale*. Common.

Of the *Papilios*, *arcyles* and *agamemnon* are the most restless and stay but a short time in one place. The contrast between their sluggish movements when drinking and their swift ordinary flight is very great.

The different species of *Terias*, though fond of drinking in groups, did not mix with the above species, nor did *Charaxes*.

Ornithoptera Brookeana is a rare butterfly in this part of Borneo; but I have seen it in several parts of the interior of the Darvel Bay peninsula. Once in the mountain region of the head-waters of the River Segama I saw a pair hovering about an orange-blossomed tree and watched them courting for twenty minutes. The male was sipping the flowers, vibrating its wings rapidly like a hawk-moth, the vivid green markings flashing out as the sun played on them. Then the

female sailed down with stately flight, showing her white spots clearly, and commenced to woo. For a long time they circled over us about 6 inches apart, the female always uppermost and a little behind, so that she could see the emerald feathers of her mate. She did all the wooing. The flight was a sailing motion with a peculiar tremour of the wings, very unlike the quivering while feeding. The female during the whole time pointed her abdomen downwards. A solitary *O. flavicollis* was about and made several feeble attacks on the lovers, which they totally ignored. At length they settled high up in a tree and united, the female still uppermost.

Darwin, dealing with the courtship of butterflies, draws the conclusion that where the males are the brighter they are chosen by the females and where the females are the handsomer the males are the selecting parties*. He says: "Now the males of many butterflies are known to support the females during their marriage-flight; but in the species just named [*C. edusa*, *H. janira*, *Pieris*, *Thecla*] it is the females which support the males; so that the part which the two sexes play is reversed, as is their relative beauty. Throughout the animal kingdom the males commonly take the more active share in wooing, and their beauty seems to have been increased by the females having accepted the more attractive individuals; but with these butterflies the females take the more active part in the final marriage ceremony, so that we may suppose that they likewise do so in the wooing; and in this case we can understand how it is that they have been rendered more beautiful."

The case of *O. Brookeana* is the exact opposite of this. The female is so much rarer than the male that Künstler, who has caught over a thousand males, has taken only fifteen females. Distant says "it is still exceedingly scarce"†. The female is quite dull in comparison with her splendid mate, yet she does all the wooing, or did in the case described, which is probably a typical one. If sexual selection be really a fact of evolution, this is a case in which it can work. The females have unlimited chances of selection, and the males may be supposed to be only too glad to accept any lover. Indeed, I can only imagine sexual selection acting where there is a disparity of numbers between the sexes. Selection implies rejection, and where the sexes are practically equal in number, though the handsomer individuals may choose or be chosen

* 'Descent of Man,' ed. 2, p. 319.

† Rhop. Mal. p. 331.

first, the less favoured are just as certain to be married and leave offspring.

If one may judge by human analogy, it would seem more probable that the more numerous sex would be the more eager, and it is difficult to see why the rare female *Brookeana* should act in such a leap-year fashion. One would expect the amorous swains to swarm around coy maidens instead of behaving like lepidopterous Josephs.

In *Hestia lynceus* and *H. leuconoë* v. *labuana* we have other cases in which the female woos the male, and the allied *Ideopsis daos* I believe does the same. These butterflies fly about in pairs for days together, with a slow flapping flight, the female about a foot above the male. The female follows every turn and movement of the male, keeping a little behind him. In these cases the sexes are alike in decoration, black spots and nervures on a white or transparent ground. Why these females should court the male is a difficult problem to solve, especially as I believe there is no great disproportion in the numbers of the sexes. The equality of numbers may be a reason for the sexes being alike in decoration.

As Darwin has well said, if one sex always preponderated in numbers sexual selection would be easy to understand: "if the males were to the females as two to one, or as three to two, or even in a somewhat lower ratio, the whole affair would be simple"*. But this is by no means always the case, for though it frequently happens that the male butterflies are more numerous than the females, and rarely that the females exceed the males, there are many cases in which no such disparity is apparent.

Darwin further makes a valuable distinction between wooing and choosing. The males as a rule woo and the females choose, and probably it is rare for the wooer to be the chooser. In the case of *O. Brookeana*, however, the female was apparently both wooer and chooser. Indeed, among butterflies one can ring a number of changes between wooer and chooser, sexes similar and sexes dissimilar, sexes equal and sexes unequal, as in the following illustrations:—

* 'Descent of Man,' ed. 2, p. 213.

Name.	Wooper.	Chooser.	Sexes equal in numbers.	Sexes not equal in numbers.	Sexes alike.	Sexes not alike.	♀ active.	♀ retiring.
<i>Vanessa urticæ</i>	♂	+♀	—	..	—	..	—	—
<i>Anthocharis cardamines</i> ..	♂	+♀	..	—	..	—	—	—
<i>Apatura iris</i>	♂	+♀	..	—	..	—	..	—
<i>Pieris rapæ</i>	♀	♂	—	—	—	—
<i>Hestia leuconœ</i>	♀	♂	—	..	—	..	—	—
<i>Ornithoptera Brookeana</i> ..	♀	+♀	..	—	..	—	—	—

If we take species in which the brilliancy or beauty resides in different sexes, we find an equal dissimilarity in the courtship:—

Name.	♂ bright.	♀ bright.	♂ dull.	♀ dull.	+♀ active.	♀ in- active.	Wooper.	Chooser.
<i>O. Brookeana</i>	—	—	—	..	+♀	+♀
<i>A. cardamines</i>	—	—	—	..	♂	+♀
<i>A. iris</i>	—	—	..	—	♂	+♀
<i>H. janira</i>	—	—	..	—	..	+♀	♂ ^p

Now, according to the theory of sexual selection,

1. In *H. janira* the female has become bright because the male chose her.
2. In *A. cardamines* the male has become bright because the female chose him.

So far all is clear: in both cases the bright sex was the wooer and the dull one the chooser, and we often see the chooser refuse the wooer, thus exercising a selection. The wooed is

approached by many wooers, and we may reasonably suppose finally selects according to her or his individual taste.

But it is not so easy thus to argue about *O. Brookeana*. That the female wooed the male was evident; she came for him. That she chose him was quite as clear to my mind—the coquetting flight, following his every turn for twenty minutes, the drooped abdomen, said so almost as plainly as words. Can we suppose it was a deliberate choice after visiting many others? That she carried in her mind not only an ideal but the memory of other possible husbands who fell short of her ideal, which this one most nearly approached? Can we also believe the males, more beautiful, more active, more numerous, had lost all eagerness, and, like Shetlanders ashore, were content to be passive and petted, though wives were so scarce and so necessary? It certainly looked to me as though, being mature, she accepted the first male she met.

When, too, as we have seen, there seems so little relation between the habits, beauty, or numbers of the sexes and the sex of the wooer, it becomes difficult to see why we should introduce the complex machinery of sexual selection to perform what the ordinary laws of evolution seem equally capable of carrying out.

It may be I witnessed an abnormal case; but this is unlikely.

Leptocircus curius.—This butterfly is not at all common in British North Borneo, and I have only seen it on streams and rivers in rocky places well open to sunshine.

It is an exceedingly swift flier, darting with rapidly vibrating wings from point to point, dashing backwards and forwards over a particular patch of sand like a dragon-fly, and making considerable journeys in the day. Like many other butterflies it is methodical, frequenting the same places at the same hour; so that when once seen I could always find it again. It is an early riser, and may be caught drinking before nine o'clock. It delights in hot sunshine and is comparatively sluggish on dull days.

When drinking it has a most remarkable habit of ejecting the water from behind. Pushing its proboscis into the wet sand it takes long steady drinks, and pumps the water out astern in rhythmic squirts, forming quite a little stream. It can project the water full 3 inches. At such times it can be approached closely if no sudden movement be made. It does not always pump, and I have often watched for it in vain*.

* My friend Mr. J. Hayward Allard has recently noticed this habit in *P. sarpedon*, but the volume of water is less and the strokes slower than with *Leptocircus*.

Ornithoptera flavicollis was very common at one place on the River Tinky, where I camped all May 1888. The male seems to be the wooer, but of this I am not quite certain yet. This insect has one peculiarity of flight which may be used in courting and is certainly used on other occasions. As I have not seen it noticed in books and have had many opportunities of observing it a description may be useful.

The male in basking along the foliage on sunny river-sides often flies slowly along, moving only its fore wings, the hind wings drooping at an obtuse angle to the line of flight, trailing like a rich robe of golden silk. In a freshly caught specimen this position can easily be induced. A furrow in the inner margin of the fore wing allows the notch of the hind wing to be elevated easily without interfering with the partial action of the fore wing. In such flight the fore wings only move through a small angle.

On the inner margin of the hind wing there is a strong fold fringed with hairs, forming a pouch. In normal flight and when at rest this pouch is closed, but when the hind wing is drooped the pouch opens. It may therefore be a scent-pouch and this peculiar flight the normal courting flight.

As a rule it is only where butterflies are plentiful that the various kinds of flight can be studied, and this seldom happens in North Borneo. When it does it is always in broken weather, rain and sunshine, and on the open banks of large streams. Very dry weather produces few insects and many of them crippled; very wet weather prevents any butterflies from appearing.

XXIV.—*Third Contribution to our Knowledge of Reptiles and Fishes from the Upper Yangtze-Kiang.* By Dr. A. GÜNTHER, Keeper of the Zoological Department, British Museum*.

MR. A. E. PRATT has continued to collect at Ichang. The last collection sent by him consisted chiefly of Reptiles, some Batrachians, and a few Fishes. Species not represented in his previous collection were the following:—

REPTILES.

Eumeces xanthi, sp. n.; *Japalura yunnansis*, Anderson;

* For the two previous communications see this Journal, 1888, vol. i. pp. 165, 429.